

CARB Fuels Workshop

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Topics

- Sulfur/NO_x relationship in Predictive Model
- Sulfur Cap

Sulfur/NOx Response in Predictive Model Needs to be Fixed

- WSPA Presentation at January 26 Fuels Workshop
 - Draft model does not fit the available data
 - Caused by exclusion of studies from Tech 5 offset terms
 - Included: CRC_E60 and AAMSUOXY
 - Excluded: CRCLOSUL, CRCLOSUO and AAMALOSU

Comments Received at Workshop

- Advanced technology vehicles are more sensitive to sulfur
- Advanced technology is better represented in more recent studies
- Studies that did not include fuel sulfur <30 ppm should not be extrapolated

Are these claims valid?

Comment 1: Advanced Technology Vehicles Are More Sensitive to Sulfur

- Some tendency for an increase in the average slope for lower emitting vehicles
- Many low emitting vehicles were relatively insensitive
- The greatest sensitivities were observed for relatively high emitting vehicles

Conclusion: While there are some very low emitting vehicles that are more sensitive, there are others that are not. The range of sulfur sensitivities is represented in all Tech 5 studies, not just the studies selected by ARB.

Comment 2: Advanced Technology Vehicles Are Better Represented in More Recent Studies

- All Tech 5 studies examined vehicles of similar certification levels
- Model years spanned a narrow range
 - (1997 – 2001)
- Base emission levels were similar across most studies

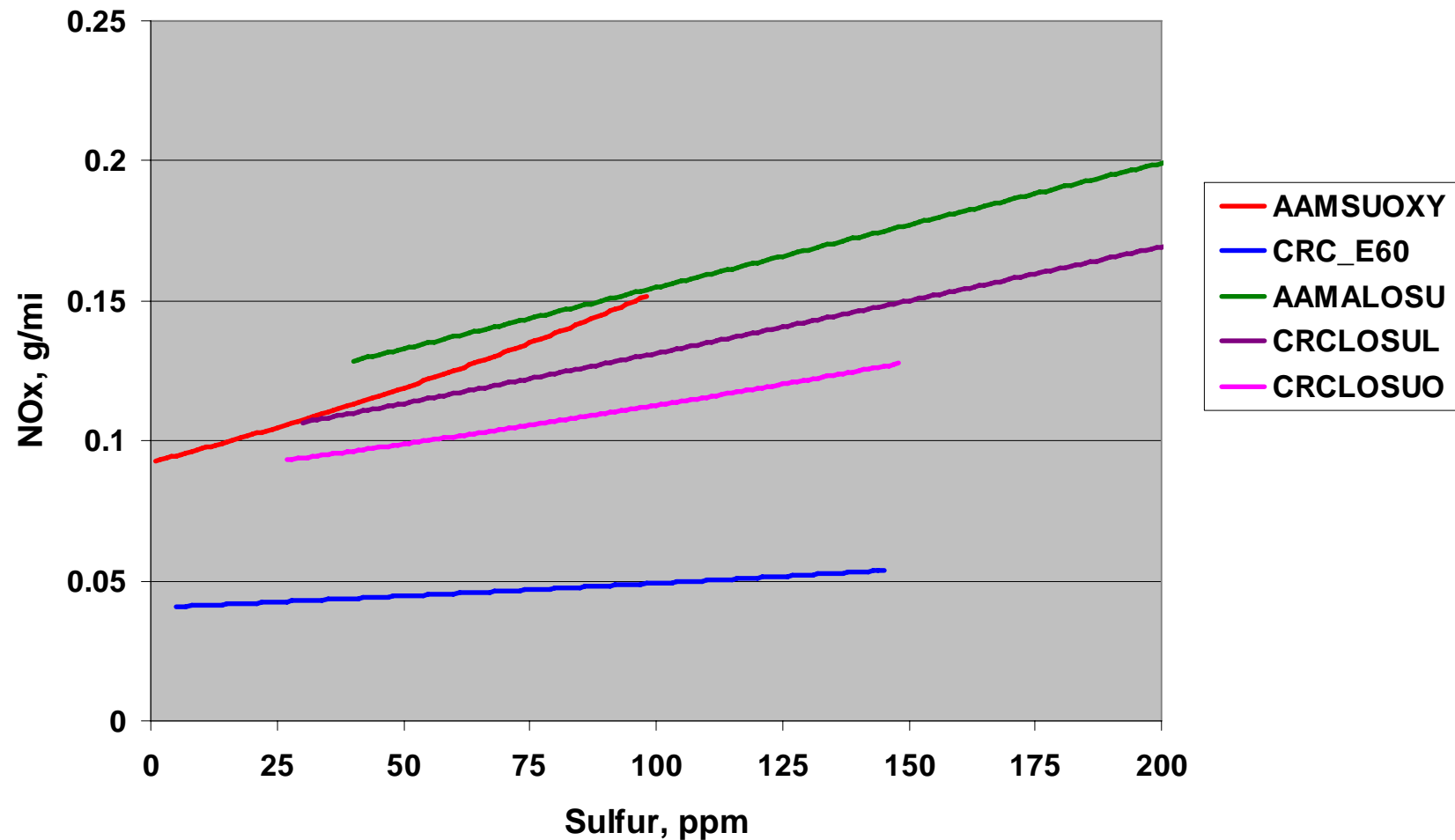
Conclusion: No evidence of enhanced representation of advanced vehicles in the studies selected by ARB

Comment 3: Extrapolation of Sulfur Data is Inappropriate

- Studies chosen by ARB are linear from 0 to 100-150 ppm sulfur
- Studies excluded by ARB include data down to 27-40 ppm sulfur
- No indication that extrapolation from 27-40 ppm to 0 ppm is inappropriate
- Extrapolation used for other fuel properties

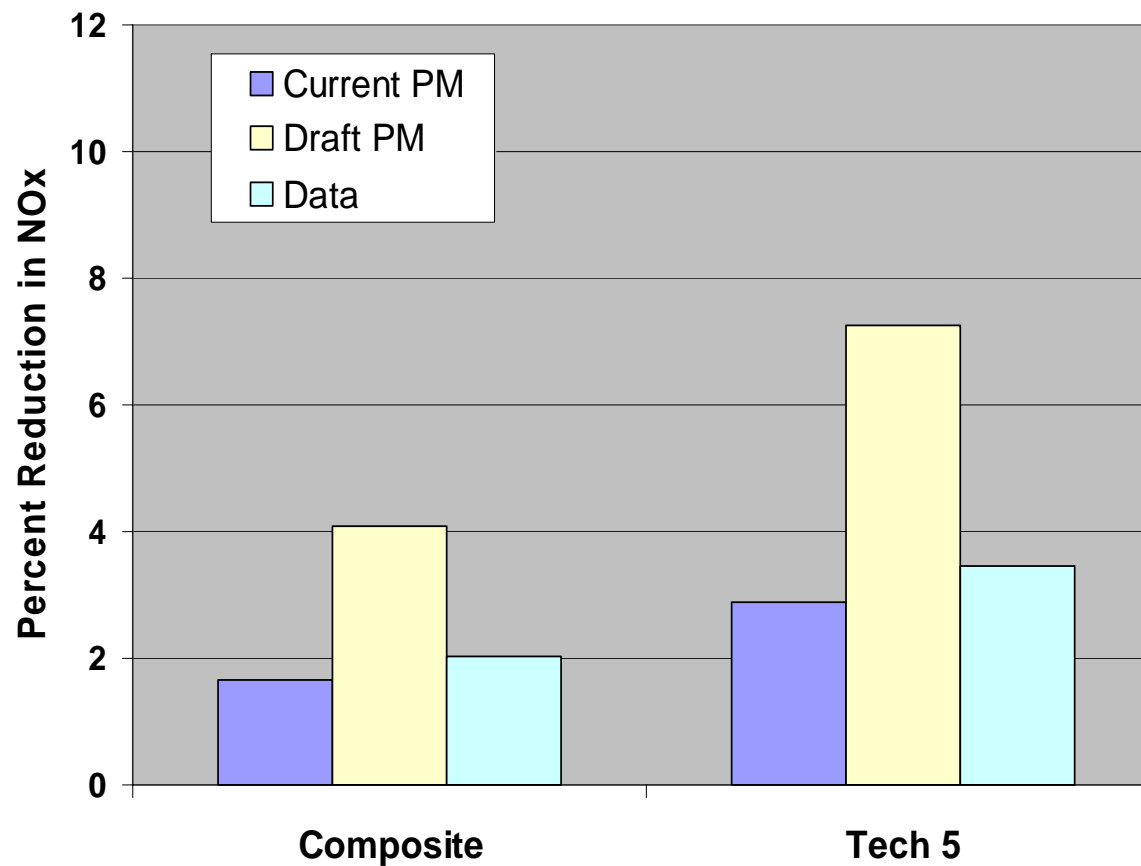
Conclusion: No justification for exclusion of data on the basis of the sulfur range of the study.

Summary of Sulfur/NO_x Studies



Comparison of Models with Data

NO_x Reduction: 20→10 ppm Sulfur



WSPA Opposes Reducing Sulfur Cap from 30 ppm to 20 ppm

- Reduces flexibility and producibility
- No emissions benefit
- Vehicles don't need it

20 ppm Sulfur Cap Will Reduce Flexibility and Producibility

- Reduces blending flexibility
 - Restricts the number of blends that are available to produce complying gasoline
 - Sulfur levels between 20-30 ppm will not be legal in emergencies, e.g. if refinery process units are down
 - + Reblending off-spec batches is even harder with steep S/NO_x response
 - Certain crudes and blending components may not be usable
- Reduced producibility a natural consequence of limited flexibility
 - Volumetric impact hard to predict, may be sporadic
- Survey data indicate that few retail samples are above 20 ppm
 - Significant mixing probably occurs in fungible distribution system

20 ppm Sulfur Cap Will Not Reduce Emissions

- Gasoline blenders need to meet the emission requirements as defined by the Predictive Model
- Cap does not impact the equations, just the possible compositions available for complying blends
- Forcing lower sulfur levels is counter to principal of setting a performance standard and letting producers meet it at lowest cost

Today's New Vehicles Don't Need Lower Sulfur

- Current new and in-use vehicles are meeting emission standards at today's sulfur levels
 - Lower sulfur will reduce OEM costs to meet vehicle emission standards; need to compare vehicle savings vs. higher fuel costs
 - Lower sulfur could reduce emissions if combined with new emission standards and certification fuel
- Lean-burn engines might require lower sulfur levels, but ...
 - Very few are being built, even outside US
 - No data on ability of lean-burn engines to meet California emission standards
 - If large scale production of lean-burn engines is planned, data should be developed by CRC on sulfur sensitivity

Summary

- There is limited ability to further reduce emissions without a potential negative effect on producibility
- The new predictive model requires significant emissions reductions to offset permeation, and in and of itself, has a potential negative impact on producibility
- A scientifically sound NOx model may have a further negative impact on producibility (applies to ethanol contents above 5.7%)
- Reducing the sulfur cap further constrains producibility
- WSPA commits to work with CARB to develop a comprehensive plan that addresses state renewable fuel initiatives and their emissions impacts

Questions?

Backup Charts

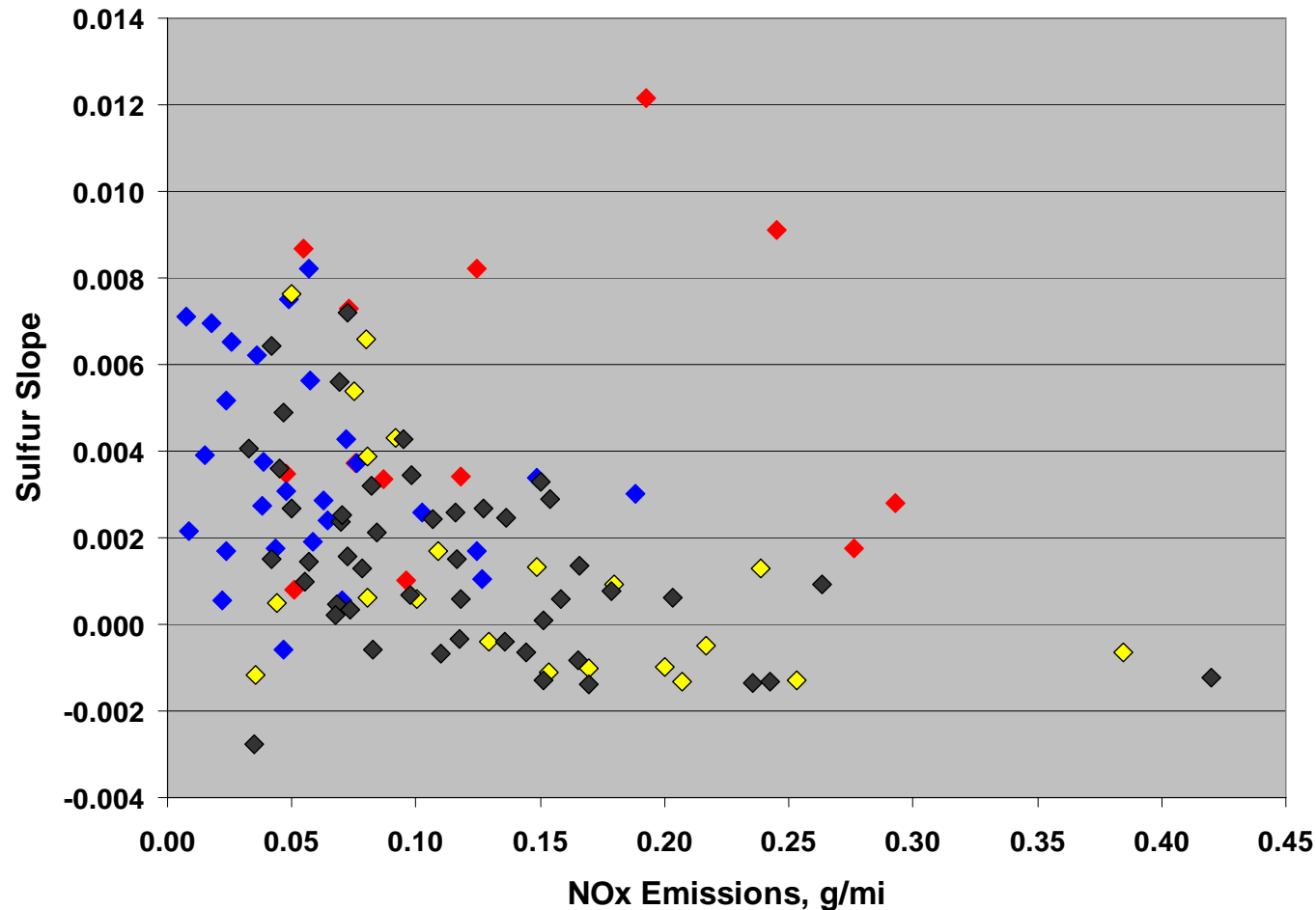
Comment 1: Advanced Technology Vehicles Are More Sensitive to Sulfur

Analysis: Examine slope vs. emissions level for individual vehicles (CARB definition)

- Emissions level
 - + Related to certification category
 - TLEV: 0.4 g/mi
 - LEV & ULEV: 0.2 g/mi
 - + Observed NO_x emissions on 27-40 ppm fuel
- Slope
 - + Fixed effect model for each study
 - + CRC_E60, AAMSUOXY, CRCLOSUO linear
 - + CRCLOSUL, AAMALOSU linearized (0-30 ppm)

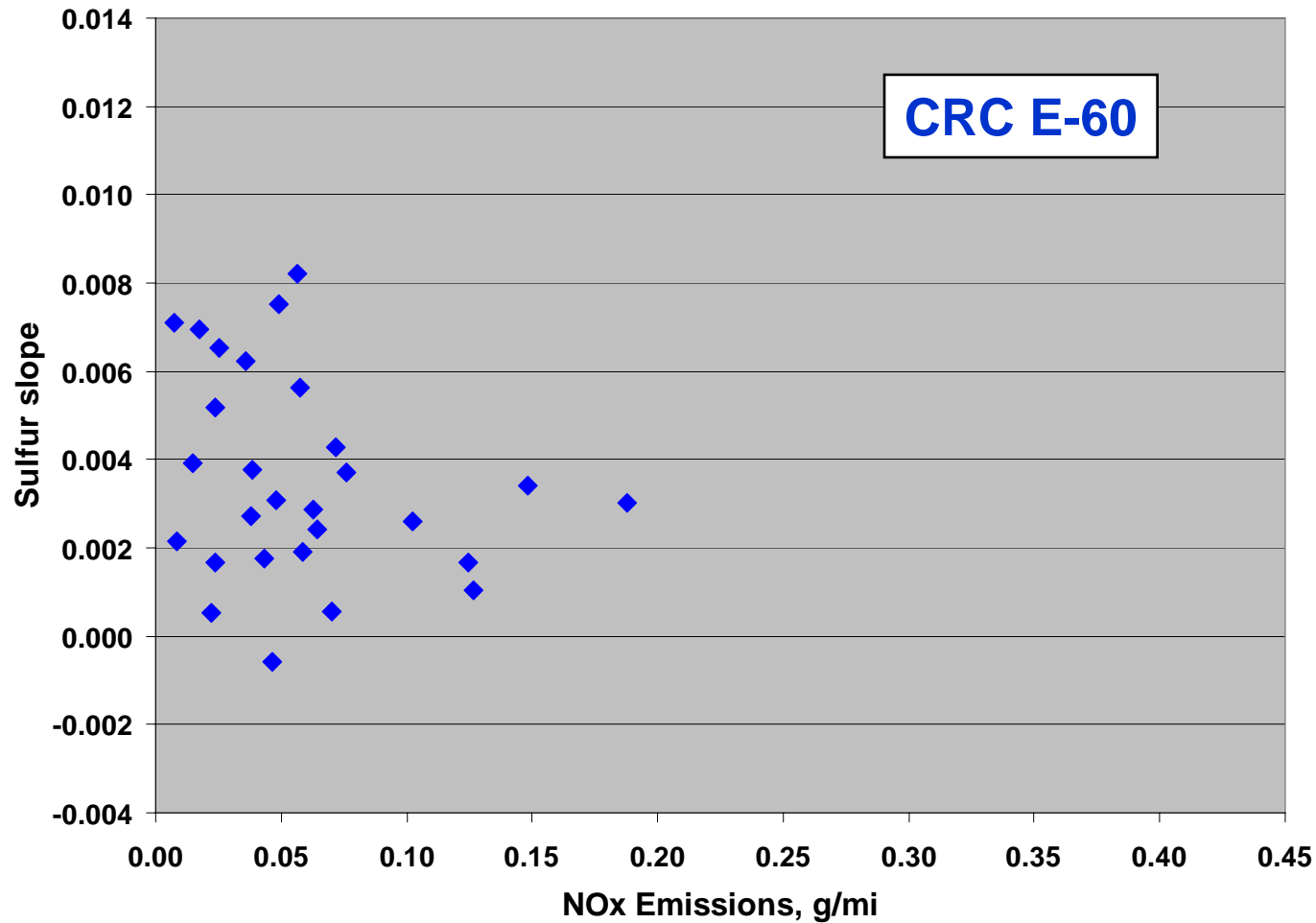
Advanced technology differences?

Slope vs. Emissions Level



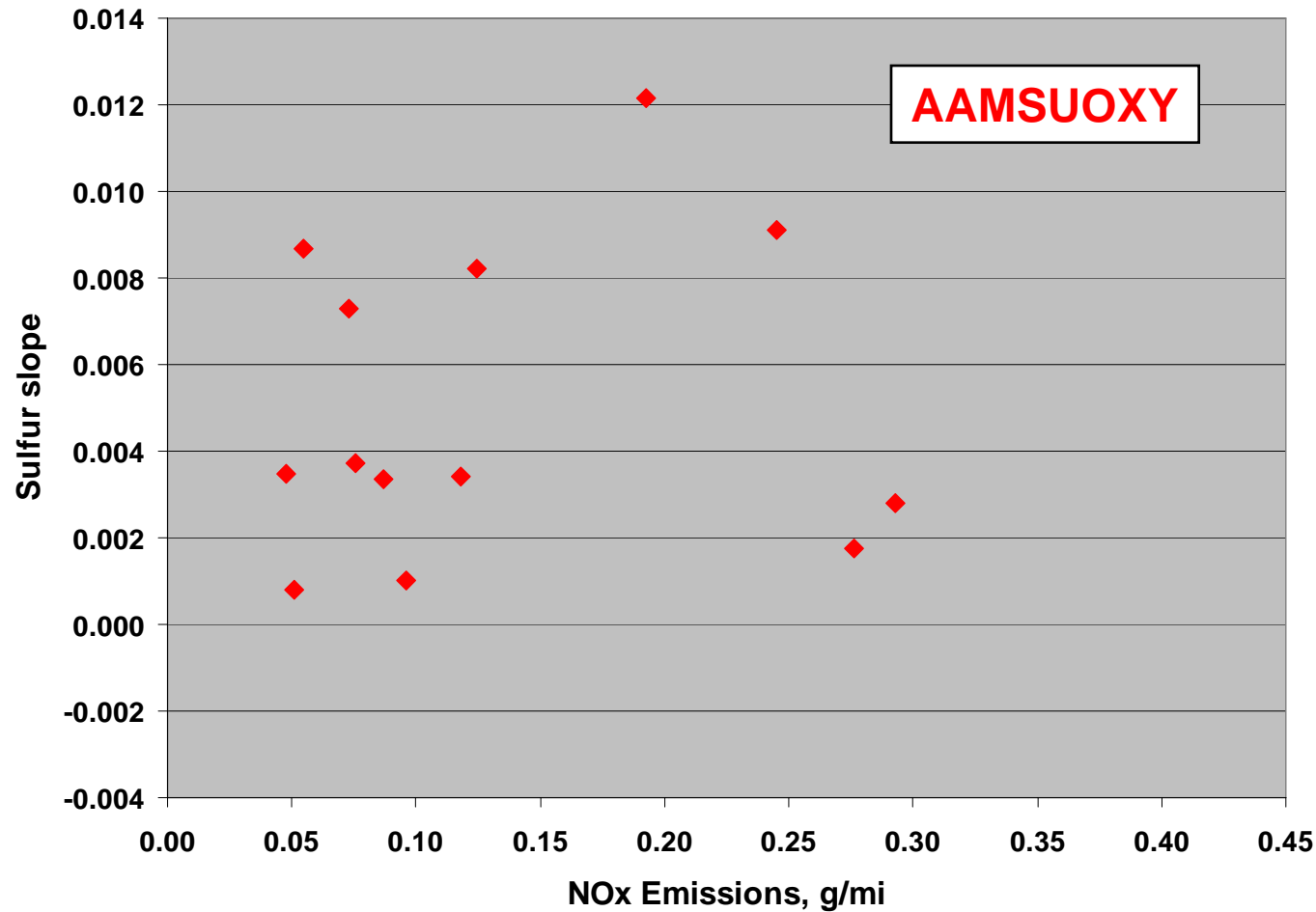
Advanced technology differences?

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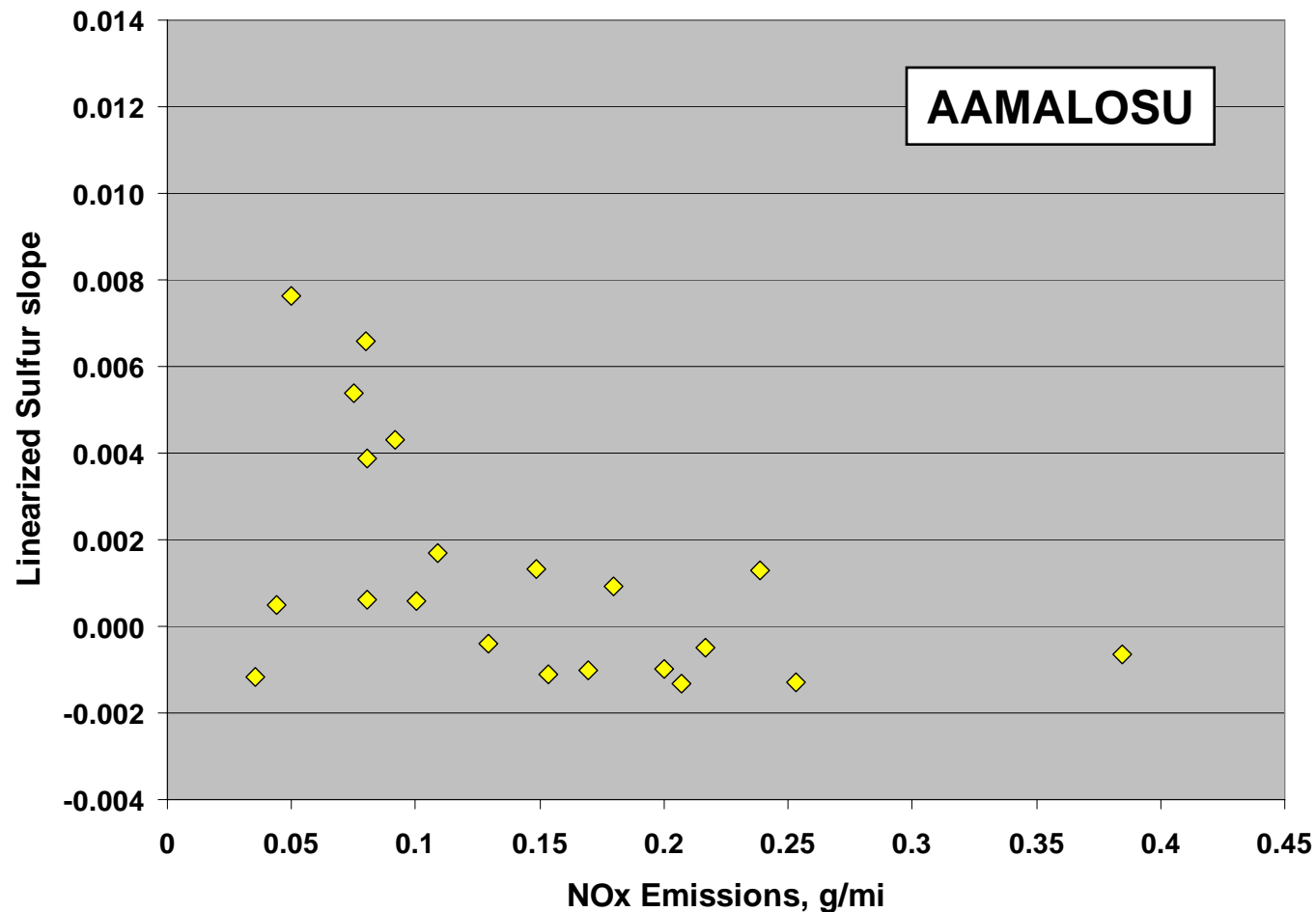
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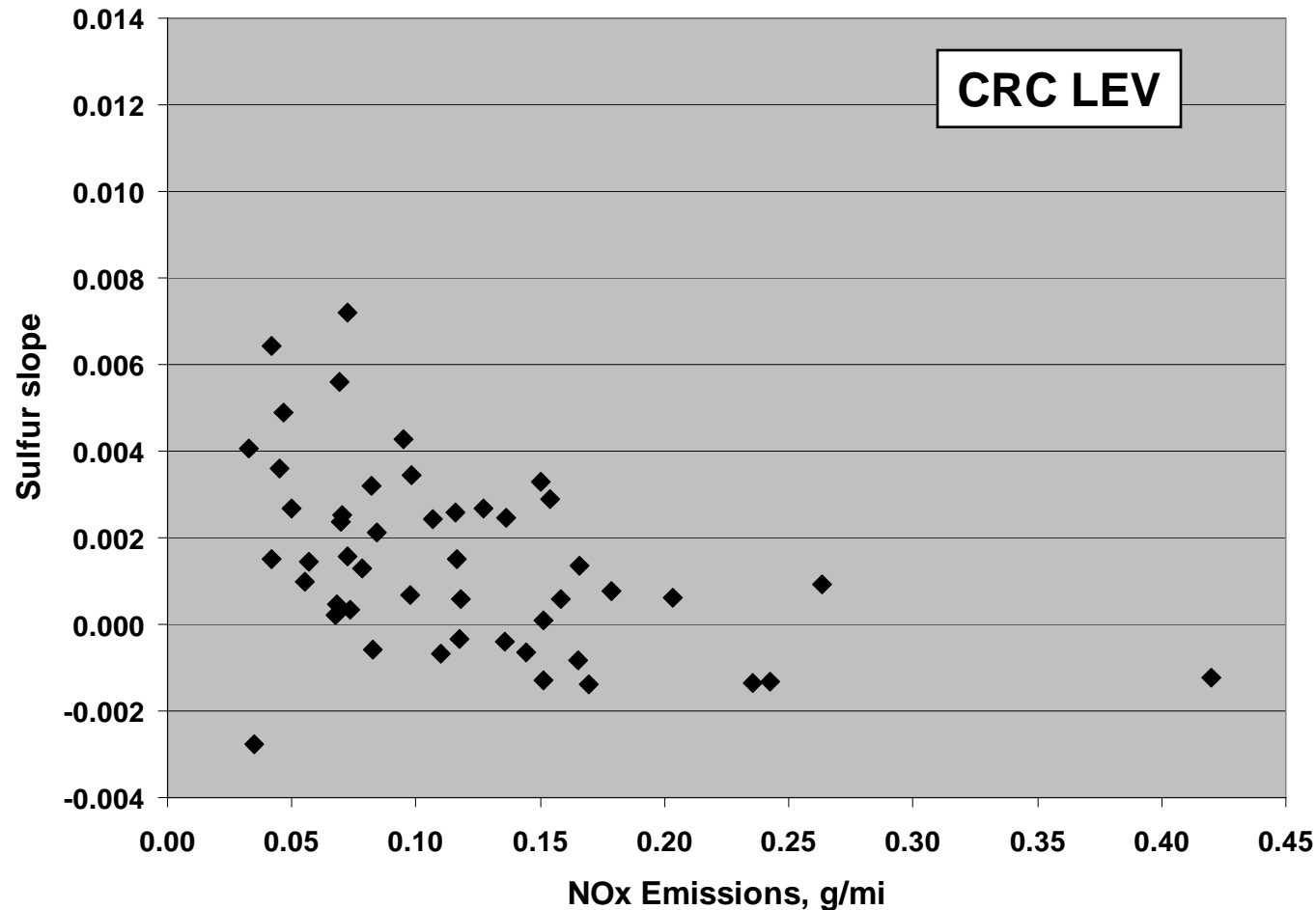
Advanced technology differences?

Slope vs. Emissions Level



Advanced technology differences?

Slope vs. Emissions Level



Comment 2: Advanced Technology Vehicles Are Better Represented in More Recent Studies

- **CRC E-60**
 - 2000-2001 MY vehicles
 - LEV, ULEV, SULEV, Euro 3
- **AAMSUOXY**
 - Vehicle model years unknown (Study completed in 1999)
 - Vehicle technologies unknown
- **CRC LEV (CRCLOSUL and CRCLOSUO)**
 - 1997 model year vehicles
 - LEV
- **AAMALOSU**
 - 1997-1999 MY vehicles
 - TLEV (1), LEV, ULEV, PULEV

Comment 2: Advanced Technology Vehicles Are Better Represented in More Recent Studies

Study	Percent of Vehicles with Emissions <0.1 g/mi
CRC_E60	82.1%
AAMSUOXY	53.8%
CRCLOSUL	50.0%
CRCLOSUO	50.0%
AAMALOSU	38.1%

Comment 3: Extrapolation of Sulfur Data is Inappropriate

- Such extrapolation required for Tech 3 & 4
- The two studies that do not require extrapolation have only one level within range
- The other studies have data in range of 27 – 40 ppm
- All studies include the range from 40 to 100 ppm